

10/23/00

LEWLETT-PACKARD COMPANY
Intellectual Property Administration
P. O. Box 272400
Fort Collins, Colorado 80528-9599

10-25-00

PATENT APPLICATION A

ATTORNEY DOCKET NO. 10990497-1

IN THE U.S. PATENT AND TRADEMARK OFFICE
Patent Application Transmittal Letter

ASSISTANT COMMISSIONER FOR PATENTS
Washington, D.C. 20231

Sir:

Transmitted herewith for filing under 37 CFR 1.53(b) is a(n): Utility Design

- original patent application,
 continuation-in-part application

JCS14 U.S. PTO
09/695184
10/23/00

INVENTOR(S): Henri Jacques Suermondt, et al

TITLE: Predicting System Health in Response to a Proposed System Intervention

Enclosed are:

- The Declaration and Power of Attorney. signed unsigned or partially signed
 5 sheets of drawings (one set) Associate Power of Attorney
 Form PTO-1449 Information Disclosure Statement and Form PTO-1449
 Priority document(s) (Other) (fee \$ _____)

CLAIMS AS FILED BY OTHER THAN A SMALL ENTITY				
(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) TOTALS
TOTAL CLAIMS	20 — 20	0	X \$18	\$ 0
INDEPENDENT CLAIMS	2 — 3	0	X \$78	\$ 0
ANY MULTIPLE DEPENDENT CLAIMS	0		\$260	\$ 0
BASIC FEE: Design \$310.00 ; Utility \$690.00				\$ 690
TOTAL FILING FEE				\$ 690
OTHER FEES				\$
TOTAL CHARGES TO DEPOSIT ACCOUNT				\$ 690

Charge \$ 690 to Deposit Account 08-2025. At any time during the pendency of this application, please charge any fees required or credit any over payment to Deposit Account 08-2025 pursuant to 37 CFR 1.25. Additionally please charge any fees to Deposit Account 08-2025 under 37 CFR 1.16, 1.17, 1.19, 1.20 and 1.21. A duplicate copy of this sheet is enclosed.

"Express Mail" label no. EL188087789USDate of Deposit 10/23/00

Respectfully submitted,

Henri Jacques Suermondt, et al

By Thomas X. Li

Thomas X. Li

Attorney/Agent for Applicant(s)

Reg. No. 37,079Date: 10/23/00Telephone No.: (650) 857-5972

I hereby certify that this is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231.

By Tiffany TurnerTyped Name: Tiffany Turner

UNITED STATES PATENT APPLICATION FOR

**PREDICTING SYSTEM HEALTH IN RESPONSE TO A
PROPOSED SYSTEM INTERVENTION**

Inventors:
Henri J. Suermondt
Evan Kirshenbaum

BACKGROUND OF THE INVENTION

Field of Invention

5 The present invention pertains to the field of systems. More particularly, this invention relates to predicting system health in response to a proposed system intervention.

Art Background

10 The operation of a wide variety of systems commonly involves system changes such as the installation of new components, the modification or reconfiguration of existing components, or the removal of existing components. For example, the 15 administration and/or maintenance of a computer system commonly involves the installation new hardware and/or software components, the modification or reconfiguration of existing hardware and/or software components, and the removal of existing 20 hardware and/or software components.

25 The components of a system commonly have dependencies with respect to one another. The software components of a computer system, for example, commonly have particular hardware requirements such as processor type or speed and/or memory requirements, etc. In addition, software components commonly have software requirements such as operating system and/or drivers, etc. Similarly, 30 the hardware components of a computer system commonly have software and/or hardware requirements.

As the number and complexities of inter-dependencies among system components increases, so does the likelihood that system changes will significantly degrade the ability of the system to function properly. Unfortunately, prior methods for performing system changes are usually ill suited to prevent system disruptions caused by the inter-dependencies among system components. For example, during installation of a new software component in a computer system a check is usually made, either manually or using installation software, to determine whether the required amount of disk space and/or processor, operating system, etc., requirements are satisfied. Any problems caused by more complex inter-dependencies must usually be discovered and dealt with after the system change is performed. Unfortunately, this typically leads to decreases in system performance and increased system down time.

SUMMARY OF THE INVENTION

An arrangement is disclosed for determining a predicted health of a system that would result from
5 an application of a proposed intervention to an existing system. The predicted health of a system may be defined as the ability of the system to function fully operationally without known impediments, slow-downs, etc.

10

The predicted health is determined by determining a set of modifications involved in the proposed intervention wherein each modification involves components of the existing system. For each
15 modification, a set of component information that pertains to the modification is obtained from a knowledge base. The component information may include prerequisites for the proposed modification, or inter-dependencies among components involved in
20 the modification. The component information enables a determination of the predicted health of individual components as well as the predicted health of the overall system. The prediction of health of individual components or of the overall system may be derived directly from the component information or
25 indirectly from predictions of other intermediate determinations that are in turn derived from the component information.

30

These techniques may be characterized as an arrangement for preventive reasoning in that they enable the detection and prevention of problems that would be caused by the proposed intervention without

degrading the performance or increasing the down time of the existing system. These techniques also enable an informed decision as to whether the intervention should be made, modified, or aborted.

Other features and advantages of the present invention will be apparent from the detailed description that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is described with respect
to particular exemplary embodiments thereof and
5 reference is accordingly made to the drawings in
which:

10 **Figure 1** shows an arrangement according to the
present teachings;

15 **Figure 2** illustrates one possible representation
of an existing system;

20 **Figure 3** illustrates one possible representation
of a proposed intervention to an existing system;

25 **Figure 4** illustrates one possible arrangement of
information in a knowledge base according to the
present techniques;

30 **Figure 5** shows actions performed by a predictor
according to the present techniques.

DETAILED DESCRIPTION

5 **Figure 1** shows a arrangement 10 according to the present teachings. The arrangement 10 includes a predictor 16 which determines a predicted system health 20 which would result from the application of a proposed intervention 14 to an existing system 12. The predictor 16 uses information contained in a knowledge base 18 in rendering the predicted system
10 health 20. In one embodiment, the predictor 16 determines the predicted system health 20 with an indication of uncertainty and may provide a probability distribution over a possible range of health states.

15 The existing system 12 represents any system which may exhibit any of the following characteristics. The existing system 12 may be characterized as one which is made up of a set of
20 components each of which may be separately installed or removed from the existing system 12. In addition, the components of the existing system 12 may be reconfigured or may have associated parameters modified. Moreover, the components of the existing
25 system 12 may have inter-dependencies with respect to one another. These inter-dependencies may be based on the configuration and/or parameters associated with the components.

30 Examples of the existing system 12 include computer systems such a personal computers, server systems, specialized controllers, test and measurement systems, and control systems.

The proposed intervention 14 specifies modifications to be applied to the existing system 12. A modification may be the installation of a new component, the removal of an existing component, or 5 the modification of an existing component or any combination of these. A modification to an existing component may involve a modification to the configuration and/or parameters associated with the existing component.

10

Examples of a modification include the installation or the removal of a hardware component, the installation or the removal or replacement, for example with a new version, of a software component, 15 the reconfiguration of a hardware or software component, and the modification of parameters associated with a hardware or software component.

20

The knowledge base 18 is an information store that contains information regarding known inter-dependencies associated with the components that may be used in the existing system 12. The inter-dependencies may be prerequisites and/or conflicts associated with the components. The inter- 25 dependencies may involve the configuration and/or parameters associated with the components. In other embodiments, information regarding known inter-dependencies, etc., may be stored in a component itself or derived in real-time from other knowledge 30 contained in the existing system 12. In addition, the knowledge base 18 may contain information regarding configuration requirements, resource requirements, etc. Also, the knowledge base 18 may

contain information other than inter-dependencies among components such as component parameter settings, and information on interactions and dependancies that is useful in determining a
5 predicted system health.

For example, the knowledge base 18 may store information indicating that a particular software component requires a particular operating system or
10 operating system version in order to function properly. The knowledge base 18 may store information indicating that a particular software component requires a particular type or speed of processor or support library. The knowledge base 18
15 may store information indicating that a particular software component conflicts with other software components or is known not to work with hardware components. The knowledge base 18 may store information indicating that a particular hardware
20 component requires a particular device driver or type or version of hardware interface or conflicts with some other hardware. The knowledge base 18 may store information indicating that a particular hardware or software component does not function properly under
25 particular configuration/and or parameters settings. The knowledge base 18 may store information indicating that a particular hardware or software component does not function properly if some other hardware or software component has some particular
30 configuration/and or parameters settings. The knowledge base 18 may store information of the health effects of not satisfying requirements.

In an alternative embodiment, the knowledge base 18 contains information that enables a mapping from information about the state, for example configuration, of one or more components to component 5 health and to system health. In such an alternative embodiment, the information in the knowledge base 18 may be used in conjunction with a proposed intervention to predict component health and/or system health, either directly or indirectly through 10 derivations or predictions about other intermediate determinations.

The information contained in the knowledge base 18 may include any information useful in determining 15 a predicted system health and may be based on experience gained in customer-support trouble shooting operations. For example, experience may be gained in customer-support troubleshooting operations. The information contained in the 20 knowledge base 18 may be based on an analysis of the actual interactions among various components that may be used in the existing system 12 and possible modifications to the components. This information may be obtained by manually or automatically 25 analyzing the log entries of actual systems that are similar to the existing system 12, by interviewing those knowledgeable about the operation of actual systems that are similar to the existing system 12, or by analyzing the domain of systems and 30 modifications to systems similar to the existing system 12 in other ways. The information contained in the knowledge base 18 may be gradually improved and updated as additional knowledge and/or experience

with modifications to systems similar to the existing system 12 is gained.

The predicted system health 20 indicates the
5 predicted health of a system that results from the application of the proposed intervention 14 to the existing system 12. The predicted system health 20 may be any indication that the system will function optimally verses sub-optimally and may be a
10 numeric value or a non-numeric or qualitative indication. The predicted system health 20 may include a list of components that have been affected, adversely or beneficially, by the application of the proposed intervention 14. The predicted system
15 health 20 may be used to render a decision, automatically or a user decision, as to whether the proposed intervention 14 should proceed or should be canceled or modified.

20 The predicted system health 20 may comprise several measures such as predicted responsiveness, reliability, availability, complexity, or ease of use. The measures may be combined to provide an overall subjective system health measure which may be
25 used individually or in combination to render decisions.

The arrangement 10 may be embodied in a computer system or network of computer systems in which the
30 existing system 12 is a model of an actual system to which the proposed intervention 14 may be applied. The existing system 12 and the proposed intervention 14 may be stored in a file system or data base or in

memory. In addition, the knowledge base 18 may be stored in a file system or data base or a memory. The predictor 16 may be an application program on the computer system and the predicted system health 20 generated by the predictor 16 may be stored in a file system or data base and/or displayed on a display device.

Figure 2 illustrates one possible representation of the existing system 12. In this embodiment, the existing system 12 is modeled as a set of components 1-n. Each component 1-n is represented using a uniform representation structure for components which includes a component identifier (ID), a configuration, and a set of parameters. The following discussion focuses on examples in which the existing system 12 is a computer system. Nevertheless, the teaching disclosed herein may be applied to numerous other types of systems.

20

Any of the components 1-n may be a software component or a hardware component. For example, the component 1 representation may be as follows:

25 Component ID: Pentium III
Configuration: Single Processor
Parameters:
Processor Speed: 500 MHZ

30 In some embodiments, the labels used in a representation, such as "Configuration" and "Parameters" may have different meanings for different entities and such name space issues may be resolved using a variety of known techniques.

In another example, the component 2 representation may be as follows:

5 Component ID: Win/NT ver. 4.0
 Configuration:
 Parameters: Service Pack 4

In yet another example, the component 3 representation may be as follows:

10 Component ID: Wordperfect ver. 7.1
 Configuration: Printer=Default
 Parameters:

In yet another example, the component 4 representation may be as follows:

15 Component ID: HP CD-ROM Model A
 Configuration:
 Parameters: Driver x.dll

20 In another example, the component 5 representation may be as follows:

 Component ID: Flight Simulator Program A
 Configuration: USB Port
 Parameters: 16-bit color, Low Resolution

25 **Figure 3** illustrates one possible representation of the proposed intervention 14. In this embodiment, the proposed intervention 14 is modeled as a set of modifications 1-m. Each modification 1-m is represented using a uniform representation structure for modifications which includes a component ID, an operation, a configuration, and a set of parameters. The component ID identifies a hardware or software component to be involved in the modification 1-m. The operation specifies operations such as install, remove, reconfigure, or modify parameters.

For example, the modification 1 representation may be as follows:

5 Component ID: ISDN modem Model C
Operation: Install
Configuration: USB
Parameters: Shared

This specifies the installation of an ISDN modem configured for USB and parameters set to "shared."

10

In another example, the modification 2 representation may be as follows:

15 Component ID: Financial Program A
Operation: Remove
Configuration:
Parameters:

In yet another example, the modification 3 representation may be as follows:

20 Component ID: Flight Simulator Program A
Operation: Modify Parameters
Configuration:
Parameters: 24-bit color, High Resolution

25 This specifies the modification of parameters for Flight Simulator Program A to 24-bit color and High Resolution graphics.

30 **Figure 4** illustrates one possible arrangement of information in the knowledge base 18. In this embodiment, the information in the knowledge base 18 is arranged into multiple sets of component information 1-x each of which specifies inter-dependencies, if any, involving the corresponding component. Each set of component information 1-x corresponds to a component which may be used in the existing system 12. Each set of component information 1-x includes a component ID, a list of

prerequisite components, and a list of component conflicts.

The component ID identifies a component to which
5 the corresponding component information 1-x applies.
The predictor 16 matches the component IDs obtained
from the existing system 12 and/or the proposed
intervention 14 to the component IDs of the component
information 1-x when looking up information from the
10 knowledge base 18.

The list of prerequisite components in each set
of component information 1-x identifies prerequisite
components, if any, for the corresponding component.
15 A list of prerequisite component contains zero or
more entries each of which includes a component ID
for a prerequisite component, a configuration for the
corresponding prerequisite component, and a set of
parameters for the corresponding prerequisite
20 component.

The list of component conflicts in each set of
component information 1-x identifies conflicting
components, if any, for the corresponding component.
25 A list of component conflicts contains zero or more
entries each of which includes a component ID for a
conflicting component, a configuration for the
corresponding conflicting component, and a set of
parameters for the corresponding conflicting
30 component.

For example, the component information 1 may be
as follows:

Component ID: Financial Program A
Prerequisite
Components: Component ID: Pentium II
Configuration:
5 Parameters: 100MHz
Component ID: RAM
Configuration:
Parameters: 16 Megabytes
Component
10 Conflicts: Component ID: Printer A
Configuration: Shared
Parameters:
Other Info:

15 In this example, the component information 1 indicates that the Financial Program A requires at least a Pentium II processor with 16 megabytes of RAM to function properly. The component information 1 indicates that the Financial Program A will not 20 function properly with the Printer A in the shared configuration.

In another example, the component information 2 may be as follows:

25 Component ID: Video codec A
Prerequisite
Components:
Component
30 Conflicts: Component ID: Graphics Card A
Configuration:
Parameters: 32-bit color
Other Info:
Component ID: DVD Player A
Configuration: USB
35 Parameters:
Other Info:

In this example, the component information 2 indicates that the Video codec A will not function 40 with the Graphics Card A in the 32-bit color configuration or with DVD Player A having a USB interface.

Each set of component information 1-x may include a set of information regarding the health effects if the corresponding prerequisite components are missing and the health effects of the 5 corresponding component conflicts exist. An explicit statement of a resulting malfunction may be specified for a missing prerequisite component. For example, this information for component 2 may indicate that the conflicting Graphics Card A may cause the Video 10 codec A to not work with MPEG2. This information may be read by the predictor 16 and used in rendering the predicted system health 20.

Figure 5 shows some of the basic method steps 15 involved in for determining the predicted system health 20 in one embodiment. The method steps 100-104 are performed by the predictor 16 for each modification and combination specified in the proposed intervention 14. The predicted system 20 health 20 is determined based on all of the modifications because later modifications may compensate for problems introduced by earlier modifications. It is desirable to ensure that the system will continue to function while the 25 modifications are being made, thereby raising concerns about system health after the initial sequence of modifications are made. It is desirable that the predictor 16 suggest things that should not be done to the system while modifications are being 30 made.

At step 100, the predictor 16 determines a modification involved in the proposed intervention

14. In a first example, the modification determined at step 100 is as follows:

5 Component ID: Application A version 2
Operation: Install
Configuration:
Parameters:

10 At step 102, the predictor 16 obtains component information from the knowledge base 18 that pertains to the modification obtained at step 100. The component information provides information regarding inter-dependencies such as prerequisite components and component conflicts, if any, involving the modification. In the first example, the predictor 16 15 searches the sets of component information 1-x for ones matching Component ID="Application A version 2." In the first example, this yields the following:

20 Component ID: Application A version 2
Prerequisite
Components: Component ID: Processor A
Configuration:
Parameters: 200 MHZ
Component ID: OS A
Configuration:
Parameters: update 1
25 Component
Conflicts: Component ID: OS A
Configuration:
Parameters: update 2
30 Other Info: no network
 printers

35 At step 104, the predictor 16 determines whether any the inter-dependencies specified in the component information obtained at step 102 are satisfied when the proposed intervention 14 is applied to the existing system 12. In the first example, the predictor 16 searches the existing system 12 and finds the following:

Component ID: Processor A
Configuration:
Parameters: 400 MHZ

5 Component ID: OS A
Configuration:
Parameters: update 2

The predictor 16 compares the prerequisite
10 component "Processor A" having a parameter of "200
MHZ" to the component information "Processor A"
having a parameter of "400 MHZ" obtained from the
existing system 12. The predictor 16 may implement a
comparison function in which the parameter "400 MHZ"
15 of the existing component "Processor A" satisfies the
prerequisite of "200 MHZ" for the "Processor A"
specified in the knowledge base 18. Thus, the
prerequisite component "Processor A" is satisfied for
the installation of the "Application A version 2."

20 The predictor 16 compares the conflicting
component "OS A" having a parameter of "update 2" to
the component information "OS A" having a parameter
of "update 2" obtained from the existing system 12
25 and finds a match. Thus, a conflicting component "OS
A" is found which will negatively impact the
installation of the "Application A." The Other Info
field of the component conflicts information for
"Application A" in this example indicates that
30 network printers will be negatively impacted.

The predictor 16 writes the predicted system
health 20 with an indication that the "Application A
version 2" in a resulting system will not have the

use of network printers based on the inter-dependancy information obtained at step 102.

The predictor 16 optionally suggests changes to
5 the proposed intervention 14 based on the inter-
dependencies obtained at step 102. In the first
example, the predictor 16 may suggest installation of
an updated version of the "Application A" if
available. The knowledge base 18 may contain
10 component information of updates of the "Application
A" and indicate whether these updates conflict with
the "update 2" of "OS A." The predictor 16 may
suggest installation of an update to the "OS A" if
available prior to the installation of "Application
15 A." The knowledge base 18 may contain component
information for updates of the "OS A" and indicate
whether these updates conflict with the "Application
A version 2." The predictor 16 may perform steps
102-104 on a proposed update of the "OS A" to predict
20 the health of the resulting system prior to
predicting the outcome of a subsequent installation
of "Application A version 2."

In a second example, the modification obtained
25 at step 100 is as follows:

Component ID: Application B version 1
Operation: Install
Configuration:
Parameters:
30

The predictor 16 obtains following component
information from the knowledge base 18 at step 102 in
the second example:

Component ID: Application B version 1
Prerequisite
35

Components: Component ID: Print driver A
Configuration:
Parameters:
Component
5 Conflicts:

In the second example, the existing system 12 does not include "Print driver A." Thus, the prerequisite component "Print driver A" is not satisfied for the installation of the "Application B version 1." The predictor 16 writes the predicted system health 20 with an indication that the "Application B version 1" in a resulting system will not work.

15 The predictor 16 suggests installation of the prerequisite "Print driver A." The predictor 16 may perform steps 102-104 on a proposed installation of the "Print driver A" to predict the health of the 20 resulting system prior to predicting the outcome of a subsequent installation of "Application B version 1."

In a third example, the modification obtained at step 100 is as follows:

25 Component ID: Hardware Component C
Operation: Modify
Configuration:
Parameters: param1=x1, param2=x2

30 The third example involves the modification of parameters for an existing "Hardware Component C." The predictor 16 obtains following component information from the knowledge base 18 at step 102 in the third example:

35 Component ID: Hardware Component C
Prerequisite
Components:

Component
Conflicts: Component ID: Driver A
Configuration:
Parameters:
5 Other Info: IF param1=x1

This indicates that "Driver A" conflicts with a "Hardware Component C" having "param1=x1." In the third example, the existing system 12 includes
10 "Driver A." Thus, the "Driver A" will conflict with "Hardware Component C" if the parameters for "Hardware Component C" are modified in accordance with the proposed modification and therefore the inter-dependancy will not be satisfied. The
15 predictor 16 writes the predicted system health 20 with an indication that the "Hardware Component C" in a resulting system will not work. In the third example, the predictor 16 suggests that the conflicting parameter modification "param1=x1" not be
20 made or that another be selected.

In a fourth example, the modification obtained at step 100 is as follows:

25 Component ID: Driver C
Operation: Remove
Configuration:
Parameters:

In the case of a component removal, the
30 predictor 16 searches the knowledge base 18 for components having the component to be removed as a prerequisite component. The predictor 16 obtains following component information from the knowledge base 18 at step 102 in the fourth example:

35 Component ID: Application C
Prerequisite
Components: Component ID: Driver C

Configuration:
Parameters:

Component
Conflicts:

5

In the fourth example, the prerequisite component "Driver C" would not be satisfied if the removal is carried out. The predictor 16 writes the predicted system health 20 with an indication that 10 the "Application C" in a resulting system will not work. In the fourth example, the predictor 16 suggests that the modification not proceed.

The information in the predicted system health 15 20 may be used to generate a health value that indicates the overall health of a system that would result from the application of the proposed intervention 14 to the existing system 12. For example, if there are S components in the resulting 20 system and the predicted system health 20 indicates that F components are negatively impacted, then one possible predicted health value is $(S-F)/S$. For example, if there are 10 components in the resulting system and 1 of them is negatively impacted then the 25 system health is $(10-1)/10 = 90$ percent.

Individual ones of the components may be weighted based on an a priori determination of the relative importance of components. These weights may 30 be used in calculating the predicted health value. A linear combination based on weight values is one example of a combination function. There may also be other functions including non-linear functions for mapping component health to overall system health. A 35 combination function may ignore certain components,

multiply their contributions, or apply a function to it. In a server system, for example, database related components may be given relatively high weight factor in comparison to rarely used applications for the server. The predicted health value may be compared to a threshold health value to determine whether the proposed intervention 14 should be applied to a system modeled by the existing system 12.

10

The foregoing detailed description of the present invention is provided for the purposes of illustration and is not intended to be exhaustive or to limit the invention to the precise embodiment disclosed. Accordingly, the scope of the present invention is defined by the appended claims.

CLAIMS

What is claimed is:

5 1. A method for determining a predicted health of a set of components of a system that would result from an application of a proposed intervention to an existing system, comprising the steps of:

10 determining a set of modifications involved in the proposed intervention, each modification involving one or more of the components of the existing system;

15 for each modification, obtaining a set of component information that pertains to the modification from a knowledge base, each set of component information specifying a set of inter-dependencies among the components involved in the modification;

20 for each modification, determining whether the inter-dependencies specified in the component information are satisfied.

25 2. The method of claim 1, wherein the inter-dependencies include a set of prerequisite components for one or more of the components.

30 3. The method of claim 2, wherein the inter-dependencies include a prerequisite configuration for one or more of the prerequisite components.

4. The method of claim 2, wherein the inter-dependencies include a prerequisite set of parameters for one or more of the prerequisite components.

5. The method of claim 1, wherein the inter-dependencies include one or more conflicting components for one or more of the components.

5 6. The method of claim 5, wherein the inter-dependencies include a conflicting configuration for one or more of the conflicting components.

10 7. The method of claim 5, wherein the inter-dependencies include a conflicting set of parameters for one or more of the conflicting components.

15 8. The method of claim 1, further comprising the step of determining one or more changes to the proposed intervention in response to the predicted health.

20 9. The method of claim 1, further comprising the step of generating a predicted health indicator by applying a combination function to a predicted health of each component in the system.

25 10. The method of claim 1, further comprising the step of determining an indication of uncertainty associated with the predicted system health.

30 11. An apparatus for determining a predicted health of a system that would result from an application of a proposed intervention to an existing system, comprising:

means for determining a set of modifications involved in the proposed intervention, each

modification involving one or more components of the existing system;

5 means for obtaining a set of component information that pertains to the modification from a knowledge base, each set of component information specifying a set of inter-dependencies among the components involved in the modification;

10 means for determining whether the inter-dependencies specified in the component information are satisfied.

12. The apparatus of claim 11, wherein the inter-dependencies include one or more prerequisite components for one or more of the components.

15 13. The apparatus of claim 12, wherein the inter-dependencies include a prerequisite configuration for one or more of the prerequisite components.

20 14. The apparatus of claim 12, wherein the inter-dependencies include a prerequisite set of parameters for one or more of the prerequisite components.

25 15. The apparatus of claim 11, wherein the inter-dependencies include one or more conflicting components for one or more of the components.

30 16. The apparatus of claim 15, wherein the inter-dependencies include a conflicting configuration for one or more of the conflicting components.

17. The apparatus of claim 15, wherein the inter-dependencies include a conflicting set of parameters for one or more of the conflicting components.
- 5 18. The apparatus of claim 11, further comprising means for determining one or more changes to the proposed intervention in response to the predicted health.
- 10 19. The apparatus of claim 11, further comprising means for generating a predicted health indicator by applying a combination function to a predicted health of each component in the system.
- 15 20. The apparatus of claim 11, further comprising means for determining an indication of uncertainty associated with the predicted system health.

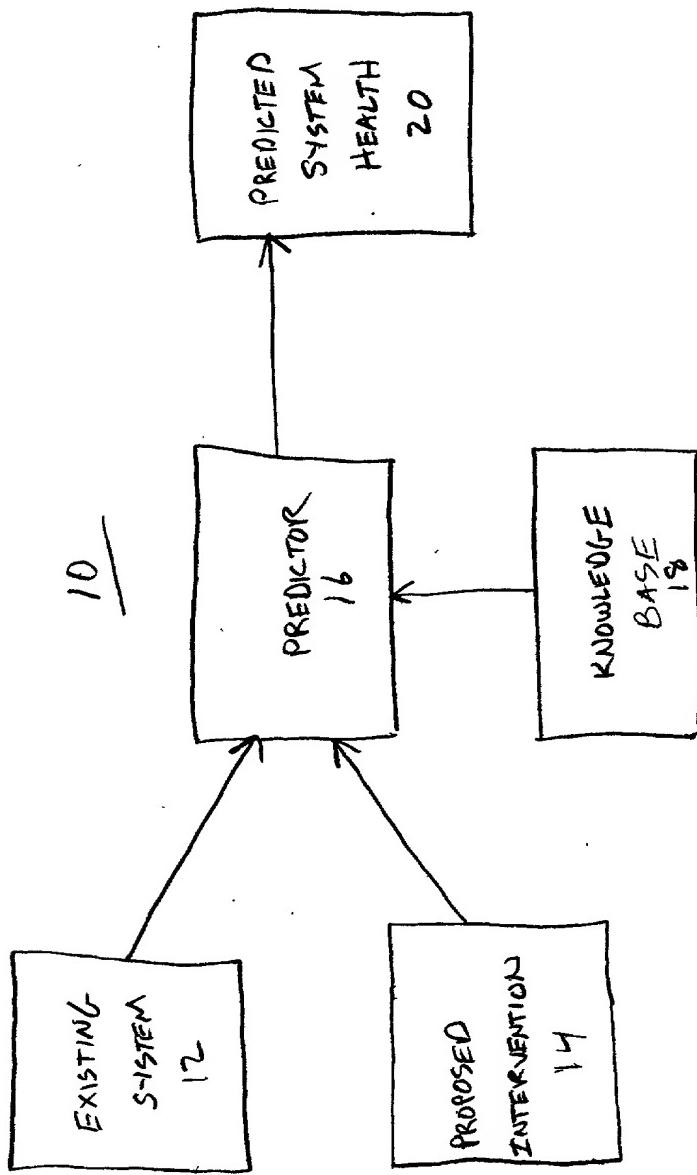
ABSTRACT

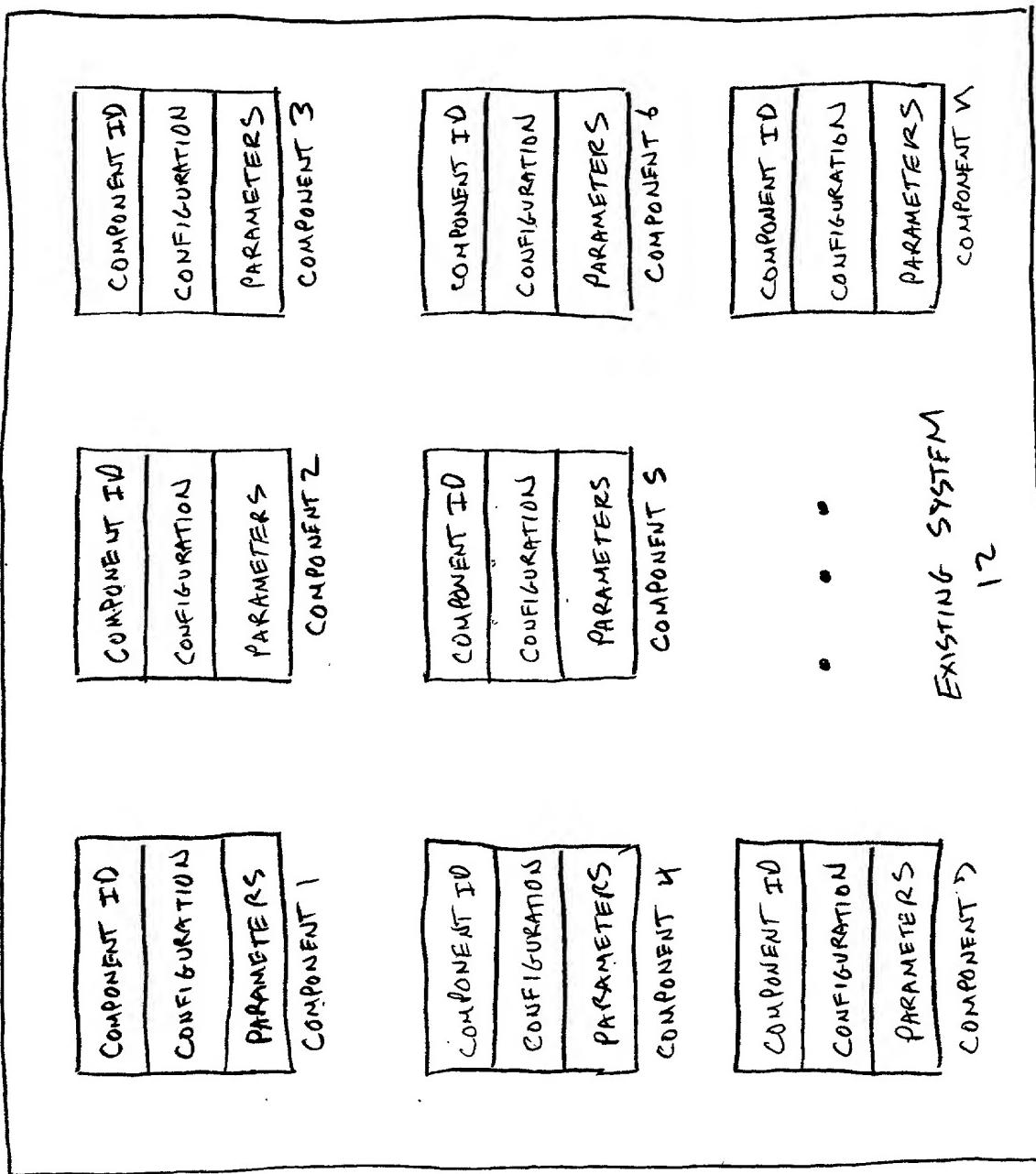
An arrangement for determining a predicted health of a system that would result from an application of a proposed intervention to an existing system. The predicted health is determined by determining a set of modifications involved in the proposed intervention wherein each modification involves one or more components of the existing system. For each modification, a set of component information that pertains to the modification is obtained from a knowledge base. Each set of component information may specify inter-dependencies among the components involved in the modification.

For each modification, it is determined whether the inter-dependencies specified in the component information are satisfied. The determination of whether the inter-dependencies are satisfied enables a determination of the predicted health of individual components of the system as well as the predicted health of the overall system.

10990497

F16 1





10990497

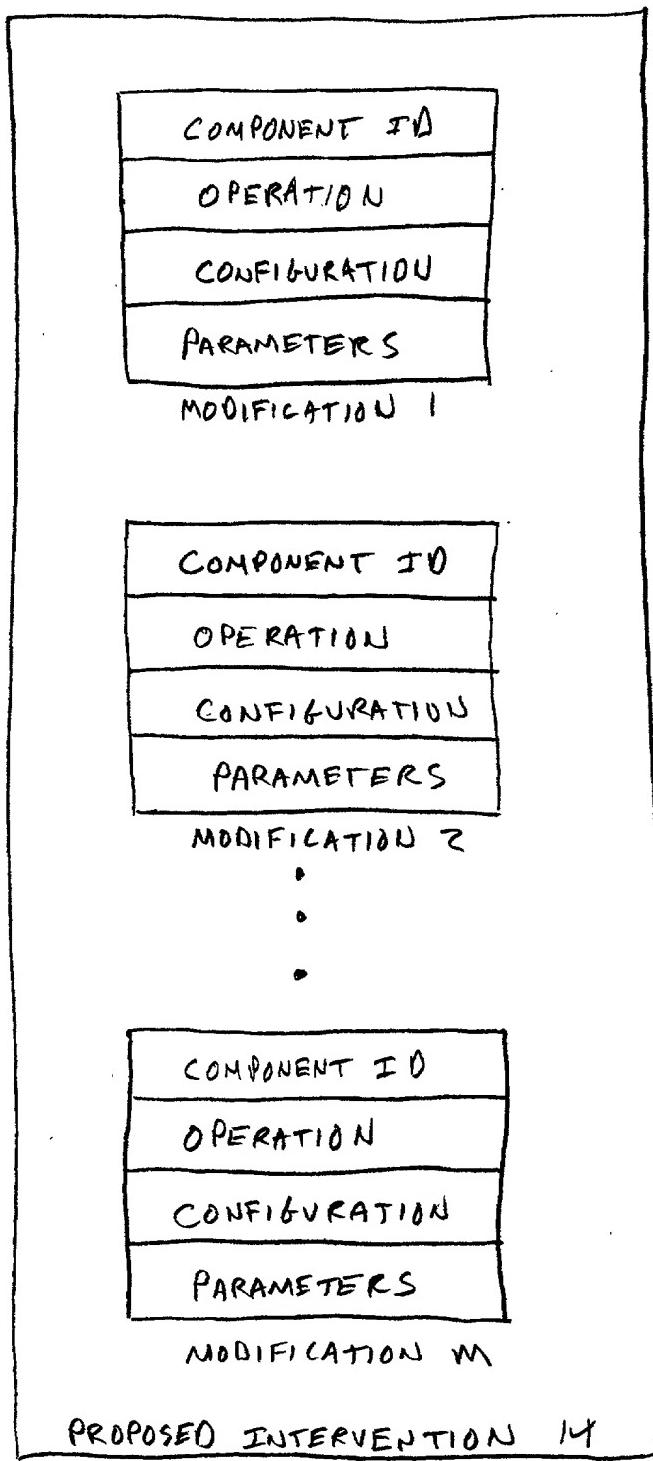


FIG 3

10990497

22-141 100 SHEETS
22-142 200 SHEETS



ANPAD
Anpad is a non-profit organization dedicated to the study and teaching of management.

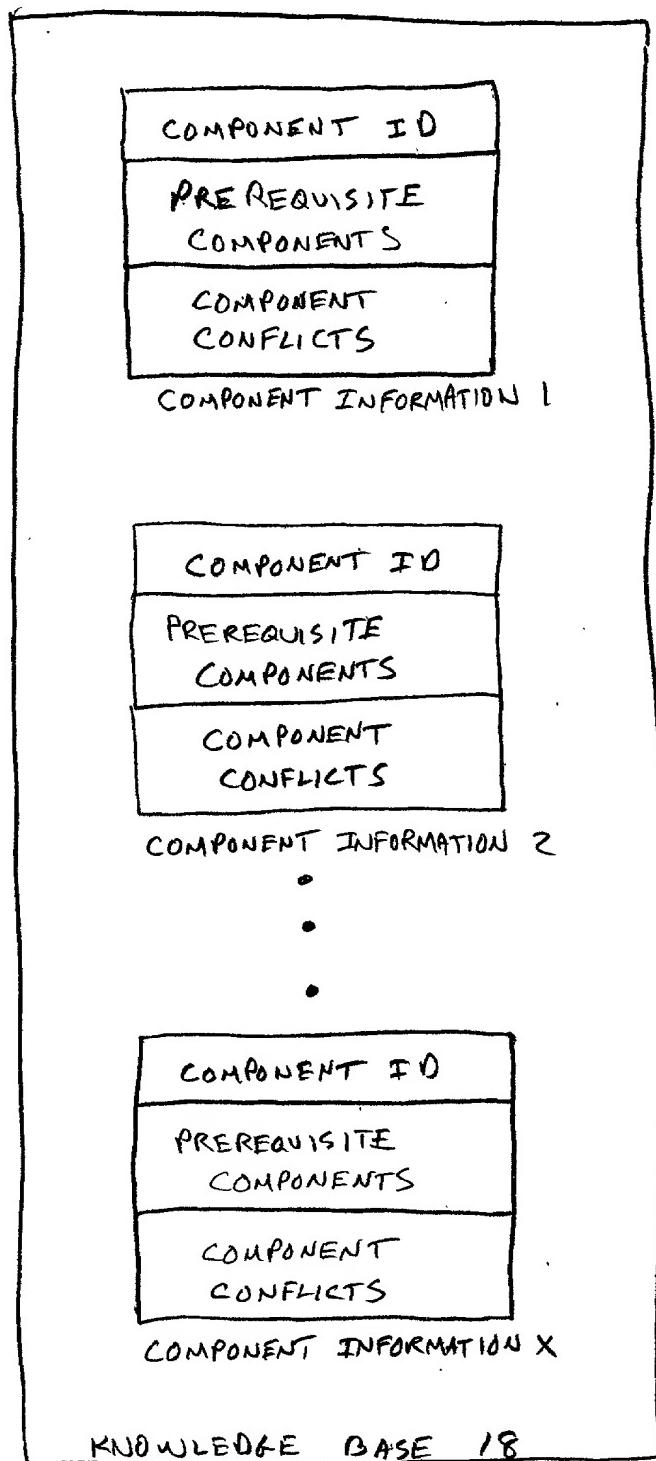


FIG 4

10990497

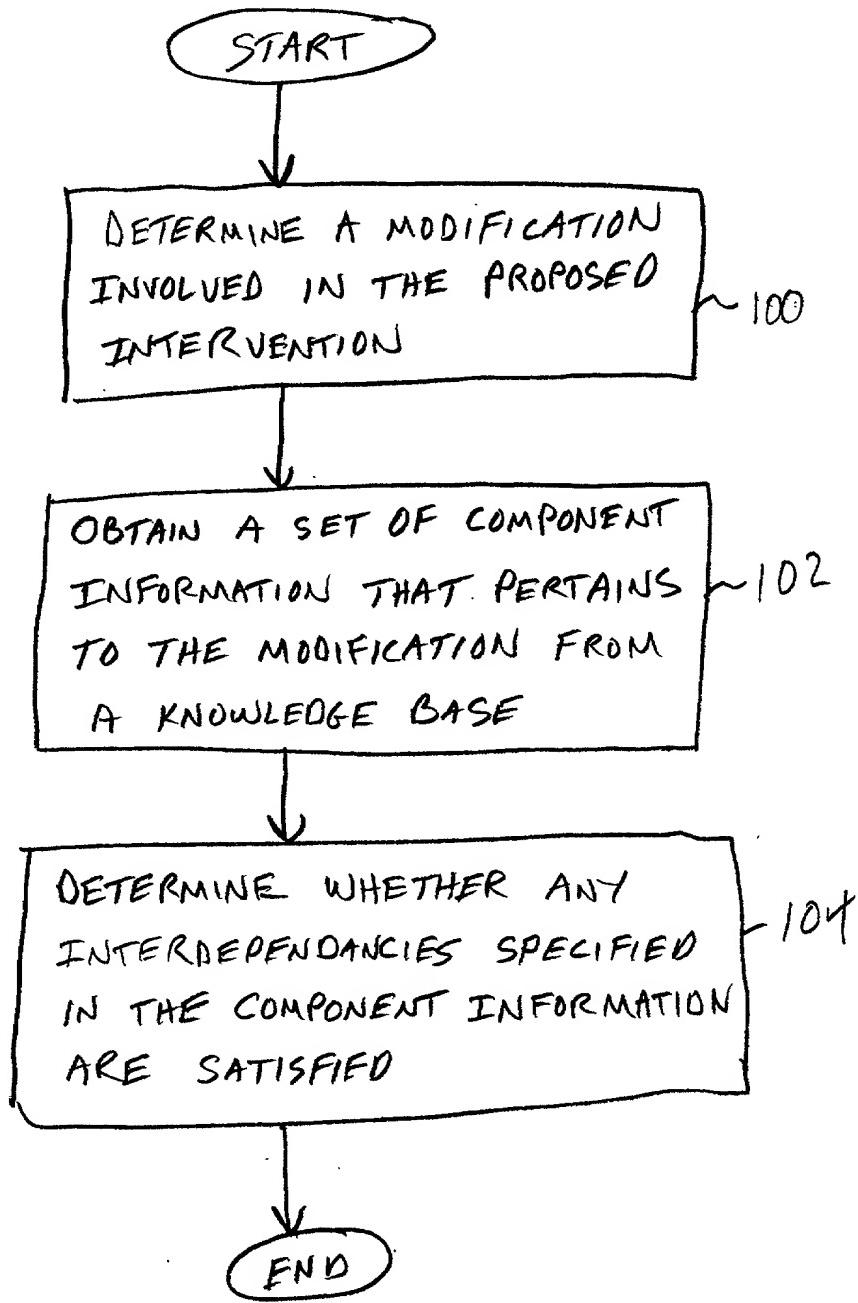


FIG 5

10990499

**DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION**
ATTORNEY DOCKET NO. 10990497-1

As a below named inventor, I hereby declare that:

My residence/post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Predicting System Health in Response to a Proposed System Intervention

the specification of which is attached hereto unless the following box is checked:

() was filed on _____ as US Application Serial No. or PCT International Application Number _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understood the contents of the above-identified specification, including the claims, as amended by any amendment(s) referred to above. I acknowledge the duty to disclose all information which is material to patentability as defined in 37 CFR 1.56.

Foreign Application(s) and/or Claim of Foreign Priority

I hereby claim foreign priority benefits under Title 35, United States Code Section 119 of any foreign application(s) for patent or inventor(s) certificate listed below and have also identified below any foreign application for patent or inventor(s) certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NUMBER	DATE FILED	PRIORITY CLAIMED UNDER 35 U.S.C 119
N/A			YES: _____ NO: _____
			YES: _____ NO: _____

Provisional Application

I hereby claim the benefit under Title 35, United States Code Section 119(e) of any United States provisional application(s) listed below:

APPLICATION SERIAL NUMBER	FILING DATE
N/A	

U. S. Priority Claim

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NUMBER	FILING DATE	STATUS (patented/pending/abandoned)
N/A		

POWER OF ATTORNEY:

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

Customer Number **022879**Place Customer
Number Bar Code
Label here

Send Correspondence to:
HEWLETT-PACKARD COMPANY
Intellectual Property Administration
P.O. Box 272400
Fort Collins, Colorado 80528-9599

Direct Telephone Calls To:
Thomas X. Li
(650) 857-5972

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Inventor: **Henri Jacques Suermond** Citizenship: **Netherlands**Residence: **2544 Mardell Way, Mountain View, CA 94043**Post Office Address: **Same**

Inventor's Signature

Date

**DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION (continued)**

ATTORNEY DOCKET NO. 10990497-1

Full Name of # 2 joint inventor: Evan R. Kirshenbaum

Citizenship: US

Residence: 441 Bella Corte, Mountain View CA 94043

Post Office Address: Same

Inventor's Signature _____

Date _____

Full Name of # 3 joint inventor: _____

Citizenship: _____

Residence: _____

Post Office Address: _____

Inventor's Signature _____

Date _____

Full Name of # 4 joint inventor: _____

Citizenship: _____

Residence: _____

Post Office Address: _____

Inventor's Signature _____

Date _____

Full Name of # 5 joint inventor: _____

Citizenship: _____

Residence: _____

Post Office Address: _____

Inventor's Signature _____

Date _____

Full Name of # 6 joint inventor: _____

Citizenship: _____

Residence: _____

Post Office Address: _____

Inventor's Signature _____

Date _____

Full Name of # 7 joint inventor: _____

Citizenship: _____

Residence: _____

Post Office Address: _____

Inventor's Signature _____

Date _____

Full Name of # 8 joint inventor: _____

Citizenship: _____

Residence: _____

Post Office Address: _____

Inventor's Signature _____

Date _____